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(РОСАВИАЦИЯ)

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для студентов I–II курсов
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Unit 1 "Queen of Sciences" Mathematics

1. Read and translate the following text

Why is the World Mathematical?

This reflection on the symmetries behind the laws of nature also tells us why mathematics is so useful in practice. Mathematics is simply the catalogue of all possible patterns. Some of those patterns are especially attractive and are studied or used for decorative purposes; others are patterns in time or in chains of logic. Some are described solely in abstract terms, while others can be drawn on paper or carved in stone. Viewed in this way, it is inevitable that the world is described by mathematics. We could not exist in a universe in which there was neither pattern nor order. The description of that order (and all the other sorts that we can imagine) is what we call mathematics. Yet, although the fact that mathematics describes the world is not a mystery, the exceptional utility of mathematics is. It could have been that the patterns behind the world were of such complexity that no simple algorithms could approximate them. Such a universe would "be" mathematical, but we would not find mathematics terribly useful. We could prove "existence" theorems about what structures exist, but we would be unable to predict the future using mathematics in the way that NASA's mission control does.

Seen in this light, we recognize that the great mystery about mathematics and the world is that such simple mathematics is so far-reaching. Very simple patterns, described by mathematics that is easily within our grasp, allow us to explain and understand a huge part of the universe and the happenings within it.

Unit 2 Four Basic Operations of Arithmetic

There are four basic operations of arithmetic. They are: addition, subtraction, multiplication and division. In arithmetic, an operation is a way of thinking of two numbers and getting one number. An equation like $3 + 5 = 8$ represents an operation of addition. Here you add 3 and 5 and get 8 as a result. 3 and 5 are addends (or summands) and 8 is the sum. There is also a plus (+) sign and a sign of equality (=). They are mathematical symbols.

An equation like $7 – 2 = 5$ represents an operation of subtraction. Here 7 is the minuend and 2 is the subtrahend. As a result of the operation, you get the difference. There is also the mathematical symbol of the minus (-) sign. We may say that subtraction is the inverse operation of addition since $5 + 2 = 7$ and $7 – 2 = 5$. The same may be said about division and multiplication, which are also inverse operations. In multiplication, there is a number that must be multiplied. It is the multiplicand. There is also a multiplier. It is the number by which we multiply. If we multiply the multiplicand by the multiplier, we get the product as a result. In the equation $5 \times 2 = 10$ (five multiplied by two is ten) five is the multiplicand, two is the multiplier, ten is the product; (×) is the multiplication sign.

In the operation of division, there is a number that is divided and it is called the dividend and the number by which we divide that is called the divisor. When we are dividing the dividend by the divisor, we get the quotient. In the equation $6 : 2 = 3$, six is the dividend , two is the divisor and three is the quotient; (:) is the division sign. But suppose you are dividing 10 by 3. In this case, the divisor will not be contained a whole number of times in the dividend. You will get a part of the dividend left over. This part is called the remainder. In our case, the remainder will be 1. Since multiplication and division are inverse operations, you may check division by using multiplication.

Phonetics 1. Read the following words according to the transcription.

Addition [əˈdɪʃ(ə)n] – сложение

subtraction [səbˈtræk.ʃən] – вычитание

multiplication [mʌltɪplɪˈkeɪʃən] – умножение

division [dɪˈvɪʒən] – деление

addend [ˈadɛnd] – слагаемое суммы

summand [ˈsʌmand] – слагаемое суммы (любой член суммы)

minuend [ˈmɪnjʊɛnd] – уменьшаемое

subtrahend [ˈsʌbtrəhɛnd] – вычитаемое

inverse [ɪnˈvɜːs] – обратный

multiplier [ˈmʌltɪplaɪə] – множитель

multiplicand [mʌltɪplɪˈkænd] – множимое

dividend [ˈdɪvɪdɛnd] – делимое

divisor [dɪˈvaɪzə] – делитель

equation [ɪˈkweɪʃən] – уравнение

quotient [kwəʊʃənt] – частное

Text Comprehension 2. Answer the following questions.

1. What are the four basic operations of arithmetic?
2. What mathematical symbols are used in these operations?
3. What are inverse operations?
4. What is the remainder?
5. How can division be checked?

Vocabulary 3. Give examples of equations representing the four basic operations of arithmetic and name their constituents. 4. Match the terms in Table A with their Russian equivalents in Table B.

Table A

1. addend 2. subtrahend 3. minuend 4. multiplier 5. multiplicand 6. quotient 7. divisor 8. dividend 9. remainder 10.inverse operation 11.equation 12.product 13. difference

Table B

a) уменьшаемое b) слагаемое c) частное d) уравнение e) делимое f) множимое g) остаток h) обратное действие i) делитель j) вычитаемое k) разность l) произведение m) множитель

5. Read the following equations aloud. Give examples of your own.

Model: 9 + 3 = 12 (nine plus three is twelve)

10 – 4 = 6 (ten minus four is six)

15 × 4 = 60 (fifteen multiplied by four is sixty)

50 : 2 = 25 (fifty divided by two is twenty five)

1. 16 + 22 = 38
2. 280 – 20 = 260
3. 1345 + 15 = 1360 15
4. 2017 – 1941 = 76
5. 70 × 3 = 210
6. 48 : 8 = 6
7. 3419 × 2 = 6838
8. 4200 : 2 = 2100

6. The italicized words are all in the wrong sentences. Correct the mistakes.

1. Multiplication is an operation inverse of subtraction. 2. The product is the result given by the operation of addition. 3. The part of the dividend which is left over is called the divisor. 4. Division is an operation inverse of addition. 5. The difference is the result of the operation of multiplication. 6. The quotient is the result of the operation of subtraction. 7. The sum is the result of the operation of division. 8. Addition is an operation inverse of multiplication.

Grammar 7. Turn from Active into Passive. Model: 1. Scientists introduce new concepts by rigorous definitions. New concepts are introduced by rigorous definitions. 2. Mathematicians cannot define some notions in a precise and explicit way. Some notions cannot be defined in a precise and explicit way. 1. People often use this common phrase in such cases. 2. Even laymen must know the foundations, the scope and the role of mathematics. 3. In each country, people translate mathematical symbols into peculiar spoken words. 4. All specialists apply basic symbols of mathematics. 5. You can easily verify the solution of this equation. 6. Mathematicians apply abstract laws to study the external world of reality. 7. A mathematical formula can represent interconnections and interrelations of physical objects. 8. Scientists can avoid ambiguity by means of symbolism and mathematical definitions. 9. Mathematics offers an abundance of unsolved problems. 10. Proving theorems and solving problems form a very important part of studying mathematics. 11. At the seminar, they discussed the recently published article. 12. They used a mechanical calculator in their work. 13. One can easily see the difference between these machines. 14. They are checking the information.

15. The researchers have applied new methods of research. 16. They will have carried out the experiment by the end of the week.

1. Read and translate the following text

What Is Programming?

A program (routine) is a complete set of instructions for doing a particular task. The process of preparing such a program is known as programming. Programming involves the following items: a. Consideration of the problem. Is the problem completely defined? Can we find a method of solution? Will the method fit the computer we use? Will we have enough time, both to prepare the solution on the computer and to run out the answers? b. Analysis of the problem. Does the algorithm that we can use exist? Are there "canned" routines that we can apply? That is, are there parts of this problem for which we may already have the computer solution? How much accuracy do we want? How well we assure ourselves that the solutions are correct? Can we construct test data to check the computer solution? Thus, programming covers all activities from the start of the job up to the end and including flowcharting. There are five steps of programming: 1. making a flow chart 2. actual coding 3. storing the final code into the computer's memory 4. debugging the code 5. running the code and tabulating the result The first step requires a clear and exact determination of all future calculations which are then presented in a flow chart. The flow chart is a diagram or a picture of a code, which is always useful for visualizing the relations between different parts of the code. This diagram is usually made before putting in a particular instruction.

There are three types of symbols used in a flow chart: (1) to represent calculation functions; (2) to show various alternatives of decisions; (3) to eliminate the spare lines and indicate which line to follow if the diagram has to follow on the next page. The second step is the process of actual coding, in which all digits are assigned to the symbols to prepare the final code. At this phase, symbolic coding aids are used. Then comes the third step when the final code is entered into the computer memory. A subroutine (subcode) may be used many times, but stored only once in the final code. The fourth step is the debugging of the code. This is the technique of detecting, diagnosing and correcting the errors which may appear in the program. And finally comes the fifth step, which consists in running the code and tabulating the results.

One of the most important details of coding is that the actual bits in the instruction are given not in a binary code. The instruction is represented in the octal equivalent. This means that two octal numbers represent the instruction, and every address will be represented by three octal numbers. 60

Phonetics 1. Read the following words according to the transcription.

Involve [ɪnˈvɒlv] – включать
flow chart [fləʊ ʧɑːt] – блок-схема
various [ˈveərɪəs] – разнообразные
diagram [ˈdaɪəgræm] – диаграмма
visualize [ˈvɪzjʊəlaɪz] – зрительно представить
eliminate [ɪˈlɪmɪneɪt] – устранить
phase [´feɪz] – этап
assign [əˈsaɪn] – присваивать
subroutine [ˈsʌbruːˌtiːn] – подпрограмма
debugging [diːˈbʌgɪŋ] – отладка
technique [tɛkˈniːk] – способ, метод, приём
octal [ˈɒktəl] – восьмеричный

Text Comprehension 2. Answer the following questions.

1. What is a program? 2. What process is known as programming? 3. What items does programming involve? 4. What questions should be kept in mind while preparing a program? 5. What are the five steps of programming? 6. What is a flow chart? 7. What is done to prepare the final code? 8. What is the third step characterized by? 9. What does debugging of the code mean? 10. What does the fifth step of programming consist in?

Unit 3 Mathematics – the Language of Science

One of the foremost reasons given for the study of mathematics is that mathematics is the language of science. This does not mean that mathematics is useful only to those who specialize in science. It implies that even a layman must know something about the foundations, the scope and the basic role played by mathematics in our scientific age. The language of mathematics consists mostly of signs and symbols, and, in a sense, is an unspoken language. There can be no more universal or simpler language. It is the same throughout the civilized world, though the people of each country translate it into their own particular language. For instance, the symbol 5 means the same to a person in England, Spain, Italy or any other country, but in each country it may be called by a different spoken word. Some of the best known symbols of mathematics are the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 and the signs of addition (+), subtraction (-), multiplication (×), division (:), equality (=) and the letters of the alphabets: Greek, Latin, Gothic and Hebrew (rather rarely). Symbolic language is one of the basic characteristics of modern mathematics for it determines its true aspect. With the aid of symbolism, mathematicians can make transitions in reasoning almost mechanically by the eye and leave their minds free to grasp the fundamental ideas of the subject matter. Just as music uses symbolism for the representation and communication of sounds, so mathematics expresses quantitative relations and spatial forms symbolically. Unlike the common language, which is the product of custom, as well as social and political movements, the language of mathematics is carefully, purposefully and often ingeniously designed. By virtue of its compactness, it permits a mathematician to work with ideas which, when expressed in terms of common language, are unmanageable. This compactness makes for efficiency of thought.

Mathematics is a special kind of language. The language so perfect and abstract that, possibly, it may be understood by intelligent creatures throughout the universe, no matter how different their organs of sense and perception may be. The grammar of the language – its proper usage – is determined by the rules of logic. Its vocabulary consists of symbols, such as numerals for numbers, letters for unknown numbers, equations for relationships between numbers and many other symbols, including the ones used in higher mathematics. All of these symbols are tremendously helpful to the scientist because they serve to cut-short his thinking. Albert Einstein wrote: "What distinguishes the language of science from language as we ordinarily understand the word? How is it that scientific language is international? The supernational character of scientific concepts and scientific language is due to the fact that they are set up by the best brains of all countries and all times."

Phonetics 1. Read the following words according to the transcription.

Hebrew [ˈhiːbruː] – древнееврейский

Gothic [ˈgɒθɪk] – готский

spatial [ˈspeɪʃəl] – пространственный

ingeniously [ɪnˈʤiːniəsli] – гениально

tremendously [trɪˈmɛndəsli] – зд. очень

compactness [ˈkɒmpæktnəs] – сжатость, лаконичность

universe [ˈjuːnɪvɜːs] –вселенная

Einstein [ˈaɪnstaɪn] – Эйнштейн

Vocabulary 2. Match the following.

1. foremost 2. Gothic 3. Hebrew 4. aid 5. transition 6. reasoning 7. spatial 8. unlike 9. common 10.by virtue of 11.ingeniously 12.compactness 13.efficiency 14.to cut-short thinking 15.perception 16.layman

a) древнееврейский язык b) главный c) готский язык d) переход e) в отличие от f) благодаря g) гениально h) лаконично i) пространственный j) обычный k) ускорять мышление l) непрофессионал m) восприятие n) точность o) мышление p) помощь

Text Comprehension 3. Answer the following questions.

1. What does the language of mathematics consist of? 2. Why is mathematics called a universal language? 3. What are the best known mathematical symbols? 4. How can mathematics be likened to music? 5. What is the most characteristic feature of the language of mathematics? 6. What are the grammar and the vocabulary of mathematics as the language of science? 7. How do mathematical symbols help the scientists in their research work? 8. How did Einstein explain the international, or supernational, character of the language of science?

Grammar 4. Say the same in a different way using conditional sentences. See the model.

Model: 34 If it were not for the works of the preceding scholars, the scientists of the following generations would not have made their discoveries. But for the works of the preceding scholars, the scientists of the following generations would not have made their discoveries.

1. If it were not for a trifling error, the experiment might have been a success. 2. But for Babylonian and Mesopotamian mathematicians, Alexandrian scholars would not have achieved such remarkable results. 3. If it were not for the unreliable equipment, there would be fewer mistakes in print. 4. But for the absurdity of the solution, we might not have noticed the error. 5. If it were not for the discovery of logarithms, the scholars of the 18th century would not have been able to make such great and successful advances. 6. But for Kepler’s enthusiasm, the tables of logarithms would not have so rapidly spread. 7. But for mathematics, the present day achievements in science and technology would have been impossible. 8. If it were not for the greatest discoveries of world-famous scholars, our life would not be so comfortable as it is now. 9. But for the computer, many sciences would not have advanced so far.

5. Identify the non-finite forms of the verb in the following text: the gerund, the participle or the infinitive.

The Value of Solving Problems in Mathematics

There is much thinking and reasoning in mathematics. The students master the subject matter not only by reading and learning, but by proving theorems and solving problems. The problems, therefore, are an important part of teaching, because they make the students discuss and reason and polish up their own knowledge. To understand how experimental knowledge is matched with theory and how new results are obtained, the students need to do their own reasoning and thinking. Of course, it is easier for both teacher and student if the text states all the results and outlines all the reasoning; but it is hard to remember such teaching for long, and harder still to get a good understanding of science from it. Solving problems, you do your own thinking, and for this reason, problems form a very important part of teaching. Some questions raised by the problems obviously do not have a single, unique or completely correct answer. More than that, the answers to them may be sometimes misleading, demanding more reasoning and further proving. Yet, thinking your way through them and making your own choice and discussing other choices are part of a good education in science and a good method of teaching.

Mathematics and Computer Science

Mathematics and Computers It is well known that the development of computers and computer science was due to the effort of mathematicians, physicists, and engineers. But the early, theoretical work came from mathematicians. The English mathematician Alan Turing, working at Cambridge University, introduced the idea of a machine that could perform mathematical operations and solve equations. The Turing machine, as it became known, was a precursor of the modern computer. Through his work, Turing brought together the elements that form the basis of computer science: symbolic logic, numerical analysis, electrical engineering, and a mechanical vision of human thought process. Computer theory is associated with the name of the outstanding scientist von Neumann, who established the basic principles on which computers operate. The first large-scale digital computers were pioneered in the 1940s. In 1945, von Neumann completed the EDVAC (Electronic Discrete Variable Automatic Computer) at the Institute of Advanced Study in Princeton. In 1946, the engineers John Eckert and John Mauchly built ENAC (Electronic Numerical Integrator and calculator), which operated at the University of Pennsylvania. Complex computers have attracted the attention of researchers in the field of artificial intelligence. They are trying to develop computer systems that can imitate human thought processes.

The mathematician Norbert Wiener, who worked at the Massachusetts Institute of Technology (MIT), also became interested in automatic computing and developed the field known as cybernetics. Cybernetics grew out of Wiener's work on increasing the accuracy of bombsights during World War II. From this, came a broader investigation of how information can be translated into improved performance. Cybernetics is now applied to communication and control systems in living organisms. Computers have exercised an enormous influence on mathematics and its applications. They have given great impetus to such branches of mathematics as numerical analysis and finite mathematics. Computer science has suggested new areas for mathematical investigation, such as the study of algorithms. Computers have also become powerful tools in diverse fields, such as number theory, differential equations, and abstract algebra. In addition, the computer has made possible the solution of several long-standing problems in mathematics which were proposed in the previ ous centuries.

Unit 4 The Number Omega

The first step on the road to omega came in a famous paper published precisely 250 years after Leibniz's essay. In a 1936 issue of the Proceedings of the London Mathematical Society, Alan M. Turing began the computer age by presenting a mathematical model of a simple, general-purpose, programmable digital computer. He then asked: "Can we determine whether or not a computer program will ever halt?" This is Turing's famous halting problem. Of course, by running a program you can eventually discover that it halts, if it halts. The problem, and it is an extremely fundamental one, is
to decide when to give up on a program that does not halt. A great many special cases can be solved, but Turing showed that a general solution is impossible. No algorithm, no mathematical theory, can ever tell us which programs will halt and which will not.

The next step on the path to the number omega is to consider the ensemble of all possible programs. Does a program chosen at random ever halt? The probability of having that happen is my omega number.

First, I must specify how to pick a program at random. A program is simply a series of bits, so flip a coin to determine the value of each bit.

How many bits long should the program be? Keep flipping the coin so long as the computer is asking for another bit of input. Omega is just the probability that the machine will eventually come to a halt when supplied with a stream of random bits in this fashion. (The precise numerical value of omega depends on the choice of computer programming language, but omega's surprising properties are not affected by this choice. And once you have chosen a language, omega has a definite value, just like pi or the number 3.) Being a probability, omega has to be greater than 0 and less than 1, because some programs halt and some do not. Imagine writing omega out in binary. You would get something like 0.1110100….

These bits after the decimal point form an irreducible stream of bits. They are our irreducible mathematical facts
(each fact being whether the bit is a 0 or a 1). Omega can be defined as an infinite sum, and each N-bit program that halts contributes precisely 1/2N to the sum. In other words, each N-bit program that halts adds a 1 to the N-bit in the binary expansion of omega. Add up all the bits for all programs that halt, and you would get the precise value of omega. This description may make it sound like you can calculate omega accurately, just as if it were the square root of 2 or the number pi. Not so — omega is perfectly well defined and it is a specific number, but it is impossible to compute in its entirety.

Memorize the following basic vocabulary and terminology to:

exponential growth — экспоненциальный рост, степенной рост

innovative solution — перспективное решение, инновационное решение

high-dimensional space — многомерное пространство

partial differential equation — дифференциальное уравнение в частных производных

least-squares approximation — приближение по методу наименьших квадратов

data dimensionality reduction — понижение размерности данных

data compression — уплотнение данных

discrete Fourier transform — дискретное преобразование Фурье

fast Fourier transform — быстрое преобразование Фурье

wavelet — вейвлет, всплеск

SUPPLEMENT

Mathematical Symbols and Operations

Σ— summation

dx— differential of x

dy— derivative of y with respect to x

dx∂y∂— partial derivative of y with respect to x

x

f(x)— function of x

lim— limit

li→m f (x)— limit f(x) as x tends to 5

x

5

log5a— logarithm of a to the base 5

lg— decimal logarithm

ln— logarithm natural

∫— integral of

∫ f (x)dx— integral of a function of x over dx

m

∫ f (x)dx— integral of a function of x over dx between limits n and m

n

sin— sine

cos— cosine

tan, tg— tangent

cjt, ctg— cotangent

Add —Прибавить, складывать

Added —Слагаемое

Item —Слагаемое

Sum —Сумма, суммировать

Summand —Слагаемое

Total —Сумма, итог, целый, подводить итог

Quantity —Количество, величина

Unknown —Неизвестное

Equality —Равенство

Example: a + b = c

Читается, как: a + b equals c; a + b is equal to c; a + b makes c; a + b is c.

SUBTRACTION — ВЫЧИТАНИЕ

Subtract —Вычитать

Less —Без, минус, за вычетом

Minuend —Уменьшаемое

Subtracted —Вычитаемое

Difference —Разность

Negative —Отрицательный

Example: a – b = c

Читается, как: a – b equals c; a – b is equal to c; b from a leaves c; a diminished by b is c.

MULTIPLICATION — УМНОЖЕНИЕ

Multiply —Умножить

Multiplicand —Множимое

Multiplier —Множитель

Factor —Множитель, коэффициент

Product —Произведение

Examples:

1 × 1 = 1 Читается, как: once one is one

2 × 2 = 4 Читается, как: twice two is four

3 × 3 = 9 Читается, как: three times three is nine

a x b = c Читается, как: a (multiplied) by b equals c.

DIVISION — ДЕЛЕНИЕ

Divide —Делить

Divided —Делимое

Divisor —Делитель

Quotient —Частное, отношение

Reminder —Остаток

Examples:

a : b = c Читается, как: a divided by b is equal to c.

a + b = c +d Читается, как: a plus b over a minus b is equal to c

a – b

c – d

plus d over c minus d.

FRACTIONS — ДРОБИ

Common fractions — простые дроби

Numerator —Числитель

Denominator —Знаменатель

Integer —Целое число

Cardinal number —Количественное числительное

Ordinal number —Порядковое числительное

Nought —Ноль (в математических выражениях)

Zero —Ноль (на шкалах)

Decimal fractions

В Англии и Америке знаки десятичных дробей отделяют точкой — point.

Каждая цифра читается отдельно. Ноль читается любым из трех способов:

Ноль целых можно совсем не читать,а только читать “point”.

Examples:

0.2 Читается, как: O point two; point two; zero point two;nought point two.

34.86 Читается, как: thirty four point eight six.

INVOLUTION — ВОЗВЕДЕНИЕ В СТЕПЕНЬ

Power —Степень, показатель степени

Base —Основание

Raise to the power —

Возводить в степень

Exponent —Показатель

Square —Квадрат, возводить в квадрат

Cube —Куб, возводить в куб

Even —Четный

Even form —Четная степень

Odd —Нечетный

Odd form —Нечетная степень

Examples:

52 Читается, как: five squared; five square; five raised to the second power; five to the power two; the second power of five.

x-5 Читается, как: x to the minus fifth (power)

y7 Читается, как: y to the seventh (power)

EVOLUTION — ИЗВЛЕЧЕНИЕ КОРНЯ

Root —Корень

Extract the root of (out of) —Извлечь корень из

Index —Показатель

Index laws —Правила действий с показателями

Indices —Показатели

Radical sign —Знак корня

Examples:

9 = 3 Читается, как: the square root of nine is three.

5 a7 Читается, как: the fifth root out of a to the power seven.

PROPORTION — ПРОПОРЦИЯ

Term —Член

Expression —Выражение

Extremes —Крайние члены пропорции

Means —Средние члены пропорции

Mean —Средний, среднее значение

Proportional —

Пропорциональный, член пропорции

Inversely —Обратно

Vary —Меняться

Vary directly (inversely) — Меняться прямо (обратно) пропор-
ционально

Constant —Постоянная величина, константа

Examples:

a : b = c : d Читается, как: a is to b as c is to d.

x = ky Читается, как: x varies directly to y; x is directly proportional to y.

x = k Читается, как: x varies inversely to y; x is inversely y proportional to y.

EQUATION — УРАВНЕНИЕ

Formula —Формула

Formulae, formulas —Формулы

Algebraic(al) —Алгебраический

Value —Величина, значение

Identity —Тождество

Examples:

(a + b)(a – b) = a2 – b2 Читается, как: the product of the sum and difference of a and b is equal to the difference of their squares.

EXAMPLES OF READING FORMULAS

2 + x +4 + x2 = 10 Читается, как: two plus x plus the square root (out) of four plus x squared is equal ten v = u

sin2i –cos2i = u Читается, как: v is equal to u square root out of sine square i minus cosine square I is equal to u

am/n = n am Читается, как: a to the m/n –th power is equal to the n-th root of the a to m-th power

Unit 5 Algebra

The earliest records of advanced, organized mathematics date back to the ancient Mesopotamian country of Babylonia and to the Egypt of the 3rd millennium BC. Ancient mathematics was dominated by arithmetic, with an emphasis on measurement and calculation in geometry and with no trace of later mathematical concepts such as axioms or proofs.

It was in ancient Egypt and Babylon that the history of algebra began. Egyptian and Babylonian mathematicians learned to solve linear and quadratic equations as well as indeterminate equations whereby several unknowns are involved.

The Alexandrian mathematicians Hero of Alexandria and Diophantus continued the traditions of Egypt and Babylon, but Diophantus' book Arithmetica is on a much higher level and gives many surprising solutions to difficult indeterminate equations. In the 9th century, the Arab mathematician Al-Khwarizmi wrote one of the first Arabic algebras, and at the end of the same century, the Egyptian mathematician Abu Kamil stated and proved the basic laws and identities of algebra.

By medieval times, Islamic mathematicians had worked out the basic algebra of polynomials; the astronomer and poet Omar Khayyam showed how to express roots of cubic equations.

An important development in algebra in the 16th century was the introduction of symbols for the unknown and for algebraic powers and operations. As a result of this development, Book 3 of La geometria (1637) written by the French philosopher and mathematician Rene Descartes looks much like a modern algebra text. Descartes' most significant contribution to mathematics, however, was his discovery of analytic geometry, which reduces the solution of geometric problems to the solution of algebraic ones.

Phonetics

Read the following words according to the transcription.

Ancient [´einSqnt] – древний

Mesopotamian [ˏmesqpq´teimjqn] – месопотамский

Babylonian [bxbi´lqunjqn] –вавилонский

Egypt [´Jgipt] – Египет

Egyptian [I´GipSqn] – египетский

Alexandria [xlig´zRndriq] – Александрия

Diophantus [dQi´Ofqntqs] – Диофант

Al-Khwarizmi [´xl kq´rizmi] – Аль Каризми

Abu Kamil [R´bH kq´mil] – Абу Камиль

Islamic [iz´lxmik] –мусульманский

Omar Khayyam [Ou´mR kei´xm] – Омар Хайям

Persian [´pWSqn] – персидский

polynomial [pOli´nOumjql] – многочлен

astronomer [qs´trOnqmq] – астроном

algebraic [xlGi´breiik] – алгебраический

philosopher [fi´lOsqfq] – философ

Rene Descartes [rq´nq dei´kRt] – Рене Декарт

Text Comprehension

true or false?

1. In the 3rd millennium BC, mathematics was dominated by arithmetic.

2. The history of algebra began in Europe.

3. The book Arithmetica was written by Diophantus.

4. One of the first Arabic algebras was written by the Arab mathematician Al-Khwarizmi.

5. The basic algebra of polynomials was worked out by Rene Descartes.

6. Omar Khayyam introduced symbols for the unknown and for algebraic powers and operations.
7. Analytic geometry was discovered by Islamic mathematicians.

3. Answer the following questions.

1. What was characteristic of ancient Mathematics?
2. Where did the history of algebra begin?
3. What equations did Egyptian and Babylonian mathematicians learn to solve?
4. Who continued the traditions of Egypt and Babylon?
5. Who was algebra developed by in the 9th century?
6. What mathematicians advanced algebra in medieval times?
7. What was an important development in algebra in the 16th century?
8. What was the result of this development?
9. What was Rene Descartes' most significant contribution to mathematics?

Vocabulary

4. Match the words on the left with their Russian equivalents on the right.

1. contribution a) решение
2. development b) вклад
3. solution c) достижение
4. records d) степень
5. quadratic e) кубический
6. to work out f) разрабатывать
7. polynomial g) открытие
8. unknown h) неизвестное
9. discovery i) многочлен

10. ancient j) корень

11. indeterminate k) древний

12. identity l) неопределённый

Grammar

5. Put the adjective or adverb in brackets in the necessary degree of comparison.

1. The scholar's (significant) contribution to mathematics was his discovery of analytic geometry.
2. Diophantus' book was on (high) level than the works of Egyptian and Babylonian mathematics.
3. (early) records of organized mathematics date back to ancient times.
4. (simple) types of calculators could give results in addition and subtraction only.
5. (often used) numbers were two and three.
6. For numbers (large) than two and three, different word-combinations were used.
7. Even (primitive) people were forced to count and measure.
8. In the 19th century, mathematics was regarded (much) as the science of relations.
9. Mathematics is said to be (close) to art than to science.
10. Mathematics becomes the science of relations and structure in (broad) sense.

Unit 6. Geometry

Geometry (Greek; geo = earth, metria = measure) arose as the field of knowledge dealing with spatial relationships.

For the ancient Greek mathematicians, geometry was the crown jewel of their sciences, reaching a completeness and perfection of methodology that no other branch of their knowledge had attained. They expanded the range of geometry to many new kinds of figures, curves, surfaces, and solids; they changed its methodology from trial-and-error to logical deduction; they recognized that geometry studies “external forms”, or abstractions, of which physical objects are only approximations; and they developed the idea of an “axiomatic theory” which, for more than 2000 years, was regarded to be the ideal paradigm for all scientific theories.

The Muslim mathematicians made considerable contributions to geometry, trigonometry and mathematical astronomy and were responsible for the development.The 17th century was marked by the creation of analytic geometry, or geometry with coordinates and equations, associated with the names of Rene Descartes and Pi. In the 18th century, differential geometry appeared, which was linked with the names of L. Euler and G. Monge.

In the 19th century, Carl Frederich Gauss, Janos Bolyai and Nikolai Ivanovich Lobachevsky, each working alone, created non-Euclidean geometry. Euclid’s fifth postulate states that through a point outside a given line, it is possible to draw only one line parallel to that line, that is, one that will never meet the given line, no matter how far the lines are extended in either direction. But Gauss, Bolyai and Lobachevsky demonstrated the possibility of constructing a system of geometry in which Euclid’s postulate of the unique parallel was replaced by a postulate stating that through any point not on a given straight line an infinite number of parallels to the given line could be drawn.

Their works influenced later researchers, including Riemann and Einstein.

Phonetics

1. Read the following words according to the transcription.

Methodology [ˌmɛθəˈdɒləʤi] – методология

trial-and-error [ˈtraɪəl ænd ˈɛrə] – метод проб и ошибок

approximation [əˌprɒksɪˈmeɪʃ(ə)n] – приближение

axiomatic [ˌæksɪəʊˈmætɪk] – аксиоматичный

external [ɛksˈtɜːnl] – внешний

paradigm [ˈpærədaɪm] – парадигма

trigonometry [ˌtrɪgəˈnɒmɪtri] – тригонометрия

Muslim [ˈmʊslɪm] – мусульманский

Pierre de Fermat [pi´er di fer´mɑ] – Пьер де Ферма

Euler [ˈɔɪlə] – Эйлер

Monge [´mɔŋʒ] – Монж

Carl Frederich Gauss [´kɑl ´fredrik ´gaus] – Карл Фридрих Гаусс

Janos Bolyai [ˈjaːnoʃ ˈboːjɒi] – Ян Боляй

Euclid [ˈjuːklɪd] – Эвклид

Euclidean [ˈjuːklɪdiən] – Эвклидовый

infinite [ˈɪnfɪnɪt] – бесконечный

Riemann [´rɪmɑn] – Риман

Einstein [ˈaɪnstaɪn] – Эйнштейн

Text Comprehension

2. Answer the following questions.

What is the origin of the term geometry?

What does geometry deal with?

What was the contribution of Greek mathematicians to the science of geometry?

Who contributed to the development of algebraic geometry?
Who was analytic geometry created by?
Whose names was differential geometry associated with?
Whose names was the creation on non-Euclidean geometry linked with?
Whose works were later influenced by non-Euclidean geometry?

Put the terms below in the correct order to show the process of the development of geometry as a science:

A. analytic geometry
B. geometry
C. differential geometry
D. non-Euclidean geometry
E. algebraic geometry

Grammar

Find the sentences with the ing-forms in the text and translate them into Russian.

Transform the following sentences into Participle I constructions.
Model:

The sign that stands for an angle …
The sign standing for an angle …
1. The line which passes through these two points is a diameter.
2. If you express these statements in mathematical terms, you obtain the following equations.
3. A decimal fraction is a fraction which has a denominator of 10, 100, 1000 or some simple multiple of 10

4. The mathematical language, which codifies the present day science so clearly, has a long history of development.
5. When we amalgamate several relationships, we express the resulting relation in terms of a formula.
6. If we try to do without mathematics, we lose a powerful tool for reshaping information.
7. Calculus, which is the main branch of modern mathematics, operates with the rules of logical arguments.
8. When we use mathematical language, we avoid vagueness and unwanted extra meanings of our statements.
9. When scientists apply mathematics, they codify their science more clearly and objectively.
10. The person who looks at a mathematical formula and complains of its abstractness, dryness and uselessness fails to grasp its true value.
11. The book is useful reading for students who seek an introductory overview to mathematics, its utility and beauty.
12. Math is a living plant which flourishes and fades with the rise and fall of civilizations, respectively.

Unit 7 The Development of Mathematics in the 17th Century

The scientific revolution of the 17th century spurred advances in mathematics as well. The founders of modern science – Nicolaus Copernicus, Johannes Kepler, Galileo, and Isaac Newton – studied the natural world as mathematicians, and they looked for its mathematical laws. Over time, mathematics grew more and more abstract as mathematicians sought to establish the foundations of their fields in logic.

The 17th century opened with the discovery of logarithms by the Scottish mathematician John Napier and the Swiss mathematician Justus Byrgius. Logarithms enabled mathematicians to extract the roots of numbers and simplified many calculations by basing them on addition and subtraction rather than on multiplication and division. Napier, who was interested in simplification, studied the systems of the Indian and Islamic worlds and spent years producing the tables of logarithms that he published in 1614 Kepler's enthusiasm for the tables ensured their rapid spread.

The 17th century saw the greatest advances in mathematics since the time of ancient Greece. The major invention of the century was calculus. Although two great thinkers - Sir Isaac Newton of England and Gottfried Wilhelm Leibniz of Germany –have received credit for the invention, they built on the work of others. As Newton noted, "If I have seen further, it is by standing on the shoulders of giants." Major advances were also made in numerical calculation and geometry.

Gottfried Leibniz was born (1st July, 1646) and lived most of his life in Germany. His greatest achievement was the invention of integral and differential calculus, the system of notation which is still in use today. In England, Isaac Newton claimed the distinction and accused Leibniz of plagiarism, that is stealing somebody else's ideas but stating that they are original. Modern-day historians, however, regard Leibniz as having arrived at his conclusions independently of Newton. They point out that there are important differences in the writings of both men.

Differential calculus came out of problems of finding tangents to curves, and an account of the method is published in Isaac Barrow's "Lectiones geometricae" (1670). Newton had discovered the method (1665-66) and suggested that Barrow include it in his book.

Leibniz had also discovered the method by 1676, publishing it in 1684 Newton did not publish his results until 1687 A bitter dispute arose over the priority for the discovery. In fact, it is now known that the two made their discoveries independently and that Newton had made it ten years before Leibniz, although Leibniz published first. The modern notation of dy/dx and the elongated s for integration are due to Leibniz.

The most important development in geometry during the 17th century was the discovery of analytic geometry by Rene Descartes and Pierre de Fermat, working independently in France. Analytic geometry makes it possible to study geometric figures using algebraic equations.

By using algebra, Descartes managed to overcome the limitations of Euclidean geometry. That resulted in the reversal of the historical roles of geometry and algebra.The French mathematician Joseph Louis Lagrange observed in the 18th century, "As long as algebra and geometry proceeded along separate paths, their advance was slow and their applications limited. But when these sciences joined company, they drew from each other fresh vitality and thenceforward marched on at a rapid pace toward perfection."

Descartes' publications provided the basis for Newton's mathematical work later in the century. Pierre de Fermat, however, regarded his own work on what became known as analytic geometry as a reformulation of Appollonius's treatise on conic sections. That treatise had provided the basic work on the geometry of curves from ancient times until Descartes.

Phonetics:

Read the following words according to the transcription.

Nicolaus Copernicus [ˌnɪkəˈleɪəs kəˈpɜːnɪkəs] – Николай Коперник

Johannes Kepler [joˈhanəs ˈkɛplə] – Иоганн Кеплер

Galilei [gælɪˈleɪi] – Галилей

Isaak Newton[ˈaɪzək ˈnjuːt(ə)n]- Исаак Ньютон

logarithms [ˈlɒgərɪðəmz] – логарифмы

John Napier [ʤɒn ˈneipɪə] – Джон Напир

Justus Byrgius [ˈʤastəs ˈbʊːʤəs] – Юстас Бирджес

Gottfried Wilhelm Leibniz [ˈgɔːtfrid ˈwɪlhɛlm ˊleɪbnits] – Готфрид Вильгельм

Лейбниц

integral [ˈɪntɪgrəl]- интеграл

Rene Descartes [rɪ´nə ˈdeɪkɑːrt] – Рене Декарт

Pierre de Fermat [pi´ər diː fer´mɑ:] – Пьер де Ферма

Joseph Louis Lagrange [ˈʤəʊzɪf ´lui lɑ´greinʒ] –Жозеф Луи Лагранж

treatise [ˈtriːtɪz] – трактат

conic [ˈkɒnɪk] - коническое сечение

Appollonius [ˌapəˈləʊnɪəs] – Аполлон

Vocabulary

Find the English equivalents in the text to the following Russian words and phrases.

1. первенство
2. сделать открытие
3. извлекать корни
4. упростить
5. плагиат
6. опубликовать
7. интегральные и дифференциальные исчисления
8. система обозначений
9. претендовать (на что-л.)
10. совершенство

Text Comprehension

Answer the following questions.

1. What scholars are considered to be the founders of modern science?
2. Why did mathematics grow more and more abstract?

3. Who were logarithms discovered by?

4. What did logarithms enable mathematicians to do?

5. What was the major invention of the 17th century?

6.What is the essence of analytic geometry?

7. Why did a dispute arise between Leibniz and Newton?

8. What enabled Descartes to overcome the limitations of Euclidean geometry?

9. Whose publications provided the basis for Newton's mathematical work later in the century?

Complete the sentences below with the words and phrases from the box.

a) Rene Descartes and Pierre de Fermat

b) Newton and Leibniz

c) the discovery of calculus

d) the scientific revolution of the 17th century

e) Kepler

f) geometry and algebra

g) the tables of logarithms

1. The Scottish mathematician Napier spent years producing …

2. The rapid spread of the tables of logarithms was ensured by …

3. The development of analytic geometry was beneficial for both …

4. The invention of calculus is connected with the names of …

5. A bitter dispute arose over the priority for…

6. Advances in mathematics were facilitated by …

7. Analytic geometry was discovered by …

Grammar

Transform the following sentences using Participle II constructions.

Model:

1. The reasons which are given for the study of mathematics …

The reasons given for the study of mathematics …

2. When they are expressed in terms of symbols, these relations produce a formula.

Expressed in terms of symbols, these relations produce a formula.

1. The procedure which was suggested at the meeting of the team had a number of advantages.
2. When they are used as scientific terms, these concepts have different meanings.
3. The formal language which is spoken in this country is Russian.
4. The tasks which were set for the students to fulfill were rather difficult.
5. If it is expressed in mathematical terms, this theorem gives a general method of calculating the area.
6. The sense which is implied in this assertion is not quite clear.
7. If it is designed and devised in a proper way, the symbol language becomes universal.
8. When math is used in any science, it brings precision, rigour and objectivity about.
9. The theory which was discussed at the seminar aroused great interest.

10 The code which has been designed by the programmer is rather inconvenient.

11 The statement which was made by the researcher did not satisfy certain conditions.

12 The rules that are learnt by the students are very important for their future professional activities.

Unit 8. ALBERT EINSTEIN

Albert Einstein is known as the greatest mathematical physicist. His relativity theory was one of the five or six great discoveries comparable to those of Galilei and Newton. Albert Einstein was born in southern Germany in 1879. As a boy, Albert was unsociable, slow and very honest. His unusual talent for mathematics and physics began to show very early. He was very good at mathematics, and at the age of twelve, he worked out his own methods for solving equations. 83 In 1896, Albert Einstein was admitted to the Zurich Polytechnic as a student in mathematics and physics. He soon realized that he was a physicist rather than a mathematician. At the age of 21, after four years of study at the university, which he graduated brilliantly, he began to work as a clerk at an office. And in 1905, he made some revolutionary discoveries in science. He published three papers. In his first paper, he explained the photoelectric effect with the help of M. Plank's quantum theory. His second paper was a mathematical development of the theory of Brownian motion. His third paper was entitled "Special Theory of Relativity".

It must be mentioned that a great contribution to the theory of relativity had been made earlier by the great mathematicians Lorenz and Poincare. Einstein's work was published in a physical journal. It stated that energy equals mass multiplied by the square of the speed of light. This theory is expressed by the equation: E = mc2 [si´skwFqd]. Scientists all over the world met this work with interest and surprise. But only very few physicists realized the importance of his theory at that time. The word relativity refers to the fact that all motion is purely relative; in a ceaselessly moving universe, no point can be fixed in place and time from which events can be measured absolutely. Another of Einstein's great discoveries was unified field theory. It was the result of 35 years of intensive research work. He expressed it in four equations where he combined the physical laws that control forces of light and energy with the mysterious force of gravitation. After his discoveries, Albert Einstein became famous. Soon he was appointed Professor of Physics at Zurich Polytechnic. Then he got the professorship at Prague, where he remained until 1913. Albert Einstein gave all his life to science. He was an extremely talented man and a great thinker.

He was always looking at the world around him with his eyes wide open, and he was always asking: "Why? Why is that so?" Einstein was a very simple, open man. His greatest quality was modesty. He was always highly critical of his own work. Einstein improved the old law of gravitation to satisfy more of the facts. In 1921, he received the Nobel Prize for physics and was elected member of the Royal Society. When the Nazis came to power in Germany in the 1930s, Einstein, who hated them, went to England, living in semi-secrecy and appearing from time to time at public protest meetings. In 1933, he went to America where he took up the post of Professor of Theoretical Physics at the Institute of Advanced Studies at Princeton. Albert Einstein died in 1955 at the age of 76. His ideas made a revolution in natural sciences of the 20th century, and his contribution to science is so great that his name is now familiar to all educated people on the planet.

Pronunciation guide Albert Einstein [´xlbqt ´QinstQin] – Альберт Эйнштейн

Zurich ˈz(j)ʊərɪk] – Цюрих

Prague [prɑːg] – Прага

the Royal Society [ðə ˈrɔɪəl səˈsaɪəti] –Академия наук

the Nazis [ðə ˈnɑːtsiz] – нацисты

Princeton [ˈprɪnstən] – Принстон

Comprehension check

1. Is Albert Einstein known mostly as a mathematician or as a physicist?
2. Whose discoveries was his relativity theory comparable to?
3. What country was he born in?

4. What qualities did he reveal in his childhood?

5. How old was Albert when he worked out his own methods for solving equations?

6. Where did he study when he realized the he preferred physics to mathematics?

7. Where did he work as professor when he became famous?

8. What kind of man was Einstein?

9. When was he awarded the Nobel Prize for physics?

10. Why did Einstein emigrate to England?

11. Where did he work in America?

12. Is Einstein one of the best known scientists of the world?

Unit 9 Read and Translate the Text.

Myths in Mathematics

There are many myths about maths, e.g., that "mathematics is the queen of the sciences" (K. Gauss); that the Internet is the cyberspace world - a new universe - and that informatics will reign and dominate throughout the 21st century (Microsoft Windows 95 experts claim). Some people believe that only gifted, talented people can learn maths, that it is only for math-minded boys, that only scientists can understand math language, that learning maths is a waste of time and efforts, etc. Some analysts claimed in 1900 that nations would face a shortage of scientists and mathematicians in particular in 1980-2000years. The myths' practical impact on today's young mathematicians seeking employment is that they should take nonacademic jobs in business, government and industry. The full unemployment rate for new math departments graduates was the highest in1992-1994.

A related myth in maths goes like this: "Jobs were tight, but the market improved. It is a cyclic business and the job market will get better soon again".

Many scientists no longer have faith in this myth and they believe that math departments in all higher educational institutions ought to reconsider their missions. In particular they should consider downsizing their graduate program and re-examine the math education provided in high schools so that the program more closely should fit the reality of what the graduates will be doing in the future. Many long-term economic, political, academic and teaching issues and problems indicate that the current employment of the new young mathematicians is not likely to be reversed in the next decade. There is sure no single answer to this employment problem.

A spectrum of changes and reforms will be needed to improve the situation. In both education and the industrial high-tech workplace the people not trained as mathematicians are doing math work and research often quite successfully nowadays. This phenomenon is the legacy of a long and profound (very deep) failure of mathematicians to communicate with other groups. For example, mathematicians believe that engineers and natural scientists are only interested in the math formulas and not in the theory of calculus. However, anyone who specializes in physical 15 chemistry or thermodynamics needs to make out (to understand) the chain rule and the implicitfunction theorem at a much deeper level than is taught in standard calculus of several variables in maths. The net result is that physicists and chemists are teaching at present these things more abstractedly and thoroughly than most math university departments. Nowadays the ordinary people no longer rank pure maths research as a top national concern.

The future of maths may depend on whether the emphasis is on the basic concepts, insight, abstract formalization and proof. This does not mean that rigorous, genuine and valid ―proof is dead, just that ―insight is playing a more important role. Successful careers in practical life often require conceptualization and abstraction of some, even engineering, problems. The majority of university graduates must be professionally adroit (skillful, clever) and flexible over a life-long career which includes many uncertain and difficult conditions of excess, insufficient or conflicting theories and data with rarely adequate time for contemplation (thinking or reasoning about).

Another myth in maths is that women cannot be genuine mathematicians. Female applicants must satisfy the same requirements at the entrance competitive examinations as boys should, there are no special tracks for girls. Most female applicants assert to have chosen to study maths because they like it rather than as a career planning. The change of high-school maths into university maths is for many of them a real shock, especially in the amount of information covered and the skills that are being developed. Despite this shock the study of higher maths should be available to a large set of students, both male and female, and not to the selected few. There is no reason that women cannot be outstanding (famous, prominent) mathematicians and the Ukrainian women mathematicians have proved it. There should be affirmative (positive) action to bring women teachers onto math faculties at colleges and universities. One cannot expect the ratio to be 50/50, but the tendency should continue until male mathematicians no longer consider the presence of female mathematicians to be unusual at math department faculty or at the conferences and congresses. Some ambitious experts claim that they think of mathematicians as forming a world nation of their own without distinctions of geographical origins, race, and creed (beliefs), sex, age or even time because the mathematicians of the past and "would-be" are all dedicated to the most beautiful of the arts and sciences. As far as math language is concerned, it is in fact too abstract and incomprehensible for average citizens. It is symbolic, too concise and precise, and often confusing to nonspecialists. The myth that there is a great deal of confusion about math symbolism, that mathematicians try by means of their peculiar language to conceal the subject matter of maths from people at large is unreasonable and meaningless. The maths language is not only the foremost means of scientists intercourse, finance, trade and business accounts, it is designed and devised to become universal for all the sciences and engineering, e.g., multilingual computer processing and translation.

Answer the questions. 1. Who called mathematics the queen of sciences? Are you agree with this statement? 2. Do you believe that only gifted and talented people can learn math? 3. Is it true that only scientists can understand math language? 4. What is the ratio of women and men teachers at maths faculties at colleges and universities in Russia?

Pre-Reading task 1. Complete the following definitions: a) Pattern: The operation, which is the inverse of addition is subtraction.

1. The operation, which is the inverse of subtraction … .

2. The quantity, which is subtracted … .

3. The result of adding two or more numbers … .

4. The result of subtracting two or more numbers … .

5. To find the sum … . 25 the number or quantity by which the dividend is divided to produce the quotient to check to find the product by multiplication

6. To find the difference … .

7. The quantity number or from which another number (quantity) is subtracted … .

8. The terms of the sum … . b) Pattern: A number that is divided is a dividend.

1. The process of cumulative addition … .

2. The inverse operation of multiplication … .

3. A number that must be multiplied … .

4. A number by which we multiply … .

5. A number by which we divide … .

6. A part of the dividend left oover after division … .

7. The number which is the result of the operation of multiplication … .

2. Choose the correct term corresponding to the following definitions:
a) The inverse operation of multiplication. addition fraction subtraction quotient division integer b) A whole number that is not divisible by integer prime number odd number complex number even number negative number c) A number that divides another number. division sign quotient remainder d) The number that is

multiplied by another. multiplication remainder multiplicand multiplier product dividend 3. Read and translate the following sentences. Write two special questions to each of them. Then make the sentences negative. 1. Everybody can say that division is an operation inverse of addition. 2. One can say that division and multiplication are inverse operations. 3. The number which must be multiplied is multiplicand. 4. We multiply the multiplicand by the multiplier. 5. We get the product as the resu1t of multiplication. 6. If the divisor is contained a whole number of times in the dividend, we won't get any remainder. 7. The remainder is a part of the dividend left over after the operation is over. 8. The addends are numbers added in addition.

Reading 1. **Give the English equivalents of the following Russian words and word combinations**: вычитаемое, величина, уменьшаемое, алгебраическое сложение, эквивалентное выражение, вычитать, разность, сложение, складывать, слагаемое, сумма, числительное, числа со знаками, относительные числа, деление, умножение, делить, остаток, частное, произведение, выражение, обратная операция, делитель, делимое, множитель, множимое, сомножители, сумма, знак умножения, знак деления.

Unit 10

Read and Translate Text into Russian.

Function Approximation and Functional Optimization In functional optimization problems, also known as infinite programming problems, functionals have to be minimized with respect to functions belonging to subsets of function spaces. Function-approximation problems, the classical problems of the calculus of variations and, more generally, all optimization tasks in which one has to find a function that is optimal in a sense specified by a cost functional belong to this family of problems. Such functions may express, for example, the routing strategies in communication networks, the decision functions in optimal control problems and economic ones.

Experience has shown that optimization of functionals over admissible sets of functions made up of linear combinations of relatively few basis functions with a simple structure and depending nonlinearly on a set of “inner” parameters (e.g., feed forward neural networks with one hidden layer and linear output activation units) often provides surprisingly good suboptimal solutions. In such approximation schemes, each function depends on both external parameters (the coefficients of the linear combination) and inner parameters (the ones inside the basis functions).

These are examples of variable-basis approximators since the basis functions are not fixed but their choice depends on the one of the inner parameters. In contrast, classical approximation schemes (such as the Ritz method in the calculus of variations) do not use inner parameters but employ fixed basis functions, and the corresponding approximators exhibit only a linear dependence on the external parameters. Then, they are called fixed basis or linear approximators. Certain variable-basis approximators can be applied to obtain approximate solutions to functional optimization problems.

This technique was later formalized as the extended Ritz method (ERIM) and was motivated by the innovative and successful application of feed forward neural networks in the late 80 s. The basic motivation to search for suboptimal solutions of these forms is quite intuitive: when the number of basis functions becomes sufficiently large, the convergence of the sequence of suboptimal solutions to an optimal one may be ensured by suitable properties of the set of basis functions, the admissible set of functions, and the functional to be optimized.

Computational feasibility requirements (i.e., memory occupancy and time needed to find sufficiently good values for the parameters) make it crucial to estimate the minimum number of computational units needed by an approximator to guarantee that suboptimal solutions are “sufficiently close” to an optimal one. Such a number plays the role of “model complexity” of the approximator and can be studied with tools from linear and nonlinear approximation theory. As compared to fixed-basis approximators, in variable-basis ones the nonlinearity of the parametrization of the variable basis functions may cause the loss of useful properties of best approximation operators, such as uniqueness, homogeneity, and continuity, but may allow improved rates of approximation or approximate optimization. Then, to justify the use of variable-basis schemes instead of fixed-basis ones, it is crucial to investigate families of function-approximation and functional optimization problems for which, for a given desired accuracy, variable-basis schemes require a smaller number of computational units than fixed-basis ones.

Unit 11
Mathematics on the Web

Over the past several years, a project has been quietly evolving that has important implications for those interested in using mathematical notation within webpages in a way that not only displays that mathematics beautifully but allows it to interact with other applications and environments. That project is MathJax, and it is an attempt to provide a universal, industrial-strength, math-on-the-web solution that is standards-based and applicable. Current users include publishers of large-scale scientific websites, bloggers and social networkers, users of course-management systems, and individual faculty members who just want to post their homework assignments easily online.

MathJax is an open-source project, drawing on the talents of a variety of individuals. Anyone who has tried to include mathematical notation in a webpage knows that this is not an easy task. The traditional solution is to use images of the equations and link those into the page to represent the mathematics. This is a cumbersome approach that has a number of drawbacks (it is hard to get the images to match the sur- rounding text, they don’t scale or print well, they cannot be easily copied, and so on). The Mathematical Markup Language (MathML) was intended to solve this problem, but for a variety of reasons, more than a decade after its specification was released, most of the major browsers still don’t support it.

The MathJax project plugs the gap left by a lack of browser support for MathML, making it possible for mathematicians —and the scientific community at large — finally to take advantage of the MathML standard and all it implies. MathJax is being developed as a platform for mathematics in webpages that works across all the major browsers (including mobile devices such as the iPad, iPhone, and Android phones). It allows authors to write their equations using several formats, including MathML and TEX, and displays the results using MathML in those browsers that MathJax does not require the viewer to download any software (though it will take advantage of certain locally installed fonts when they are present), and since it uses actual fonts, its output scales and prints better than math presented as images. Because the pages include the original TEX or MathML markup, search engines can index the mathematics within them. Since there are no images to create, the mathematics on the page can be dynamically generated and can include links and other interactive content.

Read and smile

I do not think — therefore I am not.

Old mathematicians never die; they just lose some of their functions.

Classification of mathematical problems as linear and nonlinear is like classification of the Universe as bananas and non-bananas.

SUPPLEMENT

Mathematical Symbols and Operations

ADDITION — СЛОЖЕНИЕ

Add —Прибавить, складывать

Added —Слагаемое

Item —Слагаемое

Sum —Сумма, суммировать

Summand —Слагаемое

Total —Сумма, итог, целый, подводить итог

Quantity —Количество, величина

Unknown —Неизвестное

Equality —Равенство

Example: $a + b = c$

Читается, как: a + b equals c; a + b is equal to c; a + b makes c; a + b is c.

SUBTRACTION — ВЫЧИТАНИЕ

Subtract —Вычитать

Less —Без, минус, за вычетом

Minuend —Уменьшаемое

Subtracted —Вычитаемое

Difference —Разность

Negative —Отрицательный

Example: $a – b = c$

Читается, как: a – b equals c; a – b is equal to c; b from a leaves c; a diminished by b is c.

MULTIPLICATION—УМНОЖЕНИЕ

Multiply —Умножить

Multiplicand —Множимое

Multiplier —Множитель

Factor —Множитель, коэффициент

Product —Произведение

Examples:

$1 \times 1 = 1$ Читается, как: once one is one

$2 \times 2 = 4$ Читается, как: twice two is four

$3 \times 3 = 9$ Читается, как: three times three is nine

$a \times b = c$ Читается, как: a (multiplied) by b equals c.

DIVISION — ДЕЛЕНИЕ
Divide —Делить
Divided —Делимое
Divisor —Делитель
Quotient —Частное, отношение
Reminder —Остаток
Examples:
a : b = c Читается, как: a divided by b is equal to c.
a + b = c +d Читается, как: a plus b over a minus b is equal to c
a – b
c – d
plus d over c minus d.

Decimal fractions
Америке знаки десятичных дробей отделяют точкой — point. Каждая цифра читается отдельно. Ноль читается лю-
бым из трех способов: Ноль целых можно совсем не читать, а только читать "point".
0.2 Читается, как: O point two; point two; zero point two;
nought point two.
34.86 Читается, как: thirty four point eight six.
INVOLUTION — ВОЗВЕДЕНИЕ В СТЕПЕНЬ
Power —Степень, показатель степени
Base —Основание
Raise to the power —Возводить в степень
Exponent —Показатель
Square —Квадрат, возводить в квадрат
Cube —Куб, возводить в куб
Even —Четный
Even form —Четная степень
Odd —Нечетный
Odd form —Нечетная степень

Examples:

5^2 Читается, как: five squared; five square; five raised to the
second power; five to the power two; the second power of five.
x-5 Читается, как: x to the minus fifth (power)
y7 Читается, как: y to the seventh (power)

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